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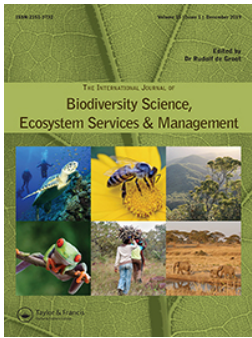
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## Values held by Swedish primary school students towards forest ecosystems and the relevance for a nature's contributions to people approach

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### ABSTRACT

How the concept of value is defined within ecosystem services operates as a filter through which important ecosystem features are identified by the specific benefits they provide to society and individuals. This value narrative reflects intrinsic and instrumental concepts which have been challenged by the Nature's Contributions to People approach in additionally highlighting the importance of relational values, stemming from socio-cultural and ethical dimensions of human relationships with nature and ecosystems. Perceived as important for the interface between ecosystems and society, relational values are yet to be operationalised in ecosystem assessment processes. This study addresses how this can be done by using a mixed-method approach encompassing quantitative and qualitative data and methodologies. Our study focuses on how school children aged 10–12 years in Sweden ( $n = 403$ ) value forest ecosystem services, and further hints at the contextual factors that mediate their value perception. Children are an important demographic for reasons of intergenerational equity, and because of the temporal inertia of intensively managed forest ecosystems in Sweden. Our results show that students display complex notions of value encompassing intrinsic, instrumental and relational values alike, highlighting the importance of a broader discussion on the valuation of ecosystems through mixed methods approaches.

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## 1. Introduction

Why we should protect nature raises fundamental questions for environmental policy about the interactions between ecosystems and society. Underpinning these interactions are values held by people which ultimately determine what aspects of nature society chooses to protect, and which stakeholders' views to consider within valuation processes and in decision-making. There are currently two major ways in which value is defined in debates over why nature should be protected. These include through intrinsic values which reflect nature's inherent value independent of people, and instrumental values which relate to the value of nature for people where nature provides tangible goods and valuable services such as climate regulation (Justus et al. 2009). These two values are often presented as separate and alternative understandings of the interface between society and ecosystems. They have attracted criticism in offering a potentially limited understanding about the different forms of value of ecosystems for society (Sala and Torchio 2019). A third category of value, termed relational value, is emerging as a potential frame through which more robust forms of value can be described within ecosystem valuation processes, providing a context through which multiple forms of value can co-exist within environmental policy (Chan et al. 2016).

Value is a debated concept within ecosystem valuation (Iniesta-Arandia et al. 2014; Chan et al. 2016). It is often understood in economic terms, distinguishing 'use' values, for instance wood and fibres from forest ecosystems, and 'non-use' values, which include benefits derived from the existence of the ecosystem and emotional or psychological benefits resulting from the existence of an ecosystem for present or future generations (de Groot et al. 2010). Through economic valuation, the value of ecosystem services to human beneficiaries is often expressed in monetary terms (Scholte et al. 2015), justified on the basis that monetary value is easily communicated and is compatible and usable within governmental policy-making processes (Gómez-Baggethun et al. 2010; Costanza et al. 2014).

However, the conception and expression of value as monetary is contentious. It is essentially underpinned by individual and collective preferences that are expressed monetarily, meaning values which are not easily expressed this way can be obscured or ignored. As such, monetary approaches to valuation of ecosystems are criticised for their under-privileging of more psycho- and socio-cultural conceptions of value that are difficult to express in monetary terms (Jax et al. 2013; Silvertown 2015, 2016). This has been argued by some to lead to an overly simplistic understanding of ecology being reflected in policy (Potschin et al. 2016; Schröter

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and van Oudenhoven 2016). Relational values are one such category of value that are difficult to express monetarily, as they emphasise human interaction with ecosystems through relations, interactions and responsibilities to nature (Kumar and Kumar 2008; Chan et al. 2016; Ruiz-Frau et al. 2018). To date, this has received comparatively little methodical attention in how these kinds of values are elicited in the context of ecosystem valuation processes (Iniesta-Arandia et al. 2014; Díaz et al. 2015).

In particular, valuation methods within the ecosystem services (ESS) approach are criticised in giving undue weight to instrumental values over intrinsic values, while often ignoring socio- and psycho-cultural approaches to valuations and the unique forms of value they may bring (Díaz et al. 2015). By contrast, frameworks such as the 'Nature's Contributions to People' (NCP) framework recognise the importance and relevance of the former notions of value but also brings forward relational values as being key to understanding complex socio-ecological interactions between ecosystems and humans (Pascual et al. 2017). These are values which are formed from the emotional, psychological and ethical interactions between the two. How these values can be elicited methodologically through valuation processes and how they can be meaningfully included in governance regimes is a key question for research (Chan et al. 2016; Pascual et al. 2017).

In filling this gap, we study how to elicit these different elements of value in the context of forest ecosystem services (FESS) on a methodological level. In particular, we examine the interface between ecosystems and society on the level of a younger demographic by studying how to elicit these different forms of value (instrumental, intrinsic and relational) in the valuation of the contribution of ecosystems to human well-being. This discussion includes also an exploration of which factors mediate value perception in the case of relational values to give greater clarity to the characteristics of the relationships that form between young people and FESS. The focus on a younger demographic is a step towards strengthening intergenerational equity within ecosystem valuation (Stern, 2008; Frew et al. 2017) by giving a voice to the particular experience of an under-voiced section of society (Sarkki et al. 2017). The consideration of this intergenerational context takes further importance from the need for long-sighted policy interfaces between forests and society given the extended temporal nature of forest management due to long rotation times. We then inquire into which methods are more appropriate for eliciting relational values and discuss their relative strengths and weaknesses. Finally, we discuss the implications that this study has for contemporary developments in related policy areas, in particular regarding educational policy and nature-based integration initiatives.

## 2. Theoretical background

### 2.1 Ecosystem services to nature's contributions to people

There are fundamental differences between the conceptions of value underpinning the ESS and NCP frameworks in how they approach ecosystem valuation. This has implications for the kinds of values able to be discovered through valuation processes. In particular, economic or financial metrics for measuring the value of ESS have proven difficult to evaluate cultural benefits such as spiritual well-being from an ESS approach (Schröter et al. 2014). The NCP framework by comparison intends to give a more comprehensive understanding of value in the relationship between humans and ecosystems (Díaz et al. 2018).

The creation of the NCP framework recognises a shift in the understanding of value in relation to the environment and human benefits derived from nature. In the past, traditional approaches to ecosystem service valuations generally presented value as a unidimensional concept, choosing one of the two abovementioned concepts of value (either intrinsic or instrumental) in methodological frameworks while ignoring their complex interplay (Pascual et al. 2017). In response, frameworks such as the NCP framework have arisen in recognising developments in how relational values embodied by ESS are assessed and their place within the ESS framework (Jacobs et al. 2016). By making space for relational values as a distinct form of value it elevates their position within ecosystem assessments, thereby reflecting the individual and shared relationships created between society and ecosystems above and beyond instrumental or intrinsic understandings of value (Díaz et al. 2018). Value is then seen as not something present within a service, but rather derivative of the connection humans have to nature (Chan et al. 2016). The enhanced visibility of these diverse forms of value within the framework then allows for novel application of ecosystem service assessment methods to uncover them.

This is an important distinction for the research we present. Based on our survey and focus group data, we present a more personal and relational sense of value resembling relational values, as well as further introducing contextual factors which may mediate the way in which school students in our study understand the value of forests.

### 2.2 Service dynamics – where, when and for whom?

Ecosystem services, their associated values and conferred benefits are often expressed both spatially and temporally. For example, this includes the locality of service provision and beneficiary, how these flow and interact through space (Bagstad et al., 2013; Chan et al. 2006) and changes in service provisions over time

(Brauman et al. 2007; Bastian et al. 2012). Context-specific attributes of beneficiaries involved also affect service provision. Several contextual factors influence the ways in which stakeholders view and value services and perceive benefits. These factors can include age, cultural background and socioeconomic position (McPhearson et al. 2013; Andersson et al. 2015). Thus, service provision is at least as much affected by where and when it is provided, but also for whom (Hein et al. 2006; Rambonilaza and Dachary-Bernard 2007; de Groot et al. 2010). Temporal and spatial scales play out simultaneously, with each scale interacting with one another in ways that are difficult to discern and disentangle (Serna-Chavez et al., 2014).

### 2.2.1 Temporal and contextual linkages – the case of intergenerational equity

In the context of our work, we understand intergenerational equity to be the potential change in value of ecosystem services for future stakeholders. As such, in the context of our research, studying the way younger generations (especially children) value ecosystems can provide insight into how to enliven intergenerational equity through policy.

Only a few studies analyse the ways in which children perceive ecosystem services as unique from other stakeholders. This is integral in giving greater content to specific intergenerational management and use preferences, which is something not captured by discounting (i.e. the estimation of how costs will change as a result of time preferences and a temporal lag in the distribution of burdens (Stern, 2008; Gladwin et al. 1995; Gómez-Baggethun et al. 2010; Luck et al. 2012)). Studies have analysed, for example, perceptions of biodiversity held by children in Brazil (Rosalino et al. 2017) and forest values in New Zealand (Bayne et al. 2015). Rosalino et al. (2017) discussed the effect of contextual factors, for example socio-economic background, exposure to different media sources, and parental attitudes, on children's attitudes towards conservation. By comparison, Bayne et al. (2015) studied the awareness of children on different aspects of value provided by forests. Further attempts have been made to understand how children gain knowledge about biodiversity and conservation in education (e.g. Barraza and Pineda 2003), without exploring underlying use preferences and values. These studies had limited study areas and foci and did not connect their findings to broader frameworks involving ecosystem services and values.

In the context of Swedish forests, the conflict of use values has been studied in terms of divergent stakeholder perspectives and use preferences (Haugen 2016; Nordén et al. 2017). Youth perspectives have only recently been explored in this context and focussing only on university-age students (Sandström et al. 2016). This presents an opportunity not only fill

a research gap but also to consolidate and develop knowledge of this stakeholder group, particularly in light of intergenerational equity as presented here.

## 3. Methodology

We conducted a student survey (n = 403), followed by focus group interviews with two self-selected schools to further explore the themes emerging from the student survey (n = 42). The demographic focus of our study was limited to primary school students aged 10–12 years in the Gothenburg area of Western Sweden. We made this choice because of the special relationships young people in Sweden generally develop with forests and the outdoors through socialisation and play, a key focus of relational values.

### 3.1 Student survey – data selection and survey design

We first designed and distributed a survey to explore the perceptions and understandings of specific forest ecosystem services and benefits from a school students' perspective (n = 403; translated survey is included in Supplementary material). This was done through a multi-stakeholder partnership between schools in the greater Gothenburg area, academics, the Swedish forestry industry, local politicians and other members of associated organisations. The partnership is centred around the 'Love the Forest' initiative (*Älska Skog* in Swedish) that aims to stimulate interest and innovation in the Swedish forestry industry through educational and competitive programs run with school students (ages 10–12). We distributed the surveys at student workshops taking place at the Universeum science centre in Gothenburg, which is the largest science centre in Scandinavia, with nine schools from around Gothenburg (403 responses; location of schools shown in Figure 1).

Survey questions focused on both the relationships between forest ecosystems and society that students were aware about (for Sweden as a country, as collective values) and how they perceived their personal relationship with forests (individual values). We used statistical clustering and content analysis to analyse the different data generated by these questions.

#### 3.1.1 Cluster analysis

We treated answers to the society-level question (Q3) as quantitative data for statistical analysis and organised them by answer type by using a hierarchical clustering method. This question was mostly closed-ended and asked students to select two out of seven possible aspects of forests they felt were the most important for Sweden, which each corresponded to a FESS (Table 1). There was also an opportunity for students to add additional benefits.



**Figure 1.** Left: map of Gothenburg area and participating school distribution with the number of respondents from each school in parenthesis (<https://www.google.com/maps>); right: map of Sweden and Gothenburg area in red (vectorstock.com).

**Table 1.** Coding procedure for society-level question (Q3) based on the importance of benefits from forests as defined in the survey.

Service category	Relevant answer
Provisioning	Trees to build houses and furniture, for example You can get energy from the forest (to warm your house or drive a car) You can pick mushrooms and berries in the forest
Regulating	Forests are important for the climate, because they absorb carbon dioxide from the air
Supporting	The forest is good for animals
Cultural	You can exercise in the forest and walk the dog You can relax in the forest

We clustered the responses through Ward's method using squared Euclidean distances (Ward 1963) in SPSS v24 to organise respondents by the relationships between answers and to identify the most common ways that students perceived and valued the seven different services presented. This kind of hierarchical clustering has been used in different iterations within the ecosystem services context, for example, to identify different socio-cultural indicators for land-use preferences (Iniesta-Arandia et al. 2014; Schmidt et al. 2017). In our study, clustering enabled us to group responses according to answer types and to determine the relative size of these groupings. These were categorised using the ecosystem services classification identified in Table 1.

### 3.1.2 Content analysis

We then carried out a content analysis on the question relating to personal relationships with forests and individual values (Q4 and Q5) to determine which themes were most dominant within students' responses. These questions were open-ended and asked students to note down three positive (Q4) and three potentially negative (Q5) aspects associated with being in forests. The choice to include both positive and negative aspects of forests aimed to probe into students' perceptions of ecosystem service trade-offs and disservices.

In the analysis of the responses, we used a decisive approach, which we based on a coding scheme we developed from relevant literature. The scheme was primarily based on the categorisation of relational values according to the NCP framework and informs how relational values could look in practice (Pascual et al. 2017). Secondly, literature on cultural ESS was used to supplement the NCP framework with more specific benefits that could fall under the identified categories of relational values (Fish et al. 2016; Cooper et al. 2016; Table 2). We then coded the

**Table 2.** Synthesised framework of relational values along with associated benefits for coding (Fish et al. 2016; Cooper et al. 2016; Pascual et al. 2017).

Type of relational value	Benefits
Physical and experiential interactions	Aesthetic appreciation Discovery Escape Fun Inspiration Knowledge Care
Physical, mental and emotional health	Tranquillity Security Health (physical and mental)
Way of life	Food collection Recreation
Cultural identity and sense of place Social Cohesion	Belonging Recreation

students' responses to the open-ended survey questions (Q4 and Q5) in the context of these specific benefits (see Table S1 for full coding procedure). This decisive approach to content analysis was useful as it allowed us to identify and quantify the answers in a descriptive and systematic manner in order to discover the most important benefits enjoyed by students, as well as which category of relational values these fell under (Weber 1990; Krippendorff 2013). Due to the relatively short answers given by students, the coding process and quantification of coded responses was done manually using Microsoft Excel.

We created the framework presented in Table 2 in order to connect the theory of relational values as conceived within the NCP framework to the answers given in the survey, as well as to existing work on cultural ESS. By synthesising the literature in this way, we were able to create an adapted framework that developed (and transformed) existing work on cultural ESS to fit within the NCP conception of relational values. The result is a typology for operationalising the concept of relational values in practice that describes the relevant benefits for each type of value. Detailing individual benefits within each form of value ensured that no experiences mentioned within students' answers were overlooked or oversimplified, which is a common challenge to overcome in content analysis (Morgan 1993; Krippendorff 2004).

The benefits identified in Table 2 may potentially overlap and interact with one another. For example, feelings of tranquillity, escapism or aesthetic appreciation may be accompanied by feelings of better mental health. Fun or leisure could also be considered an activity, as a result of recreational activities, or an end in of itself. Recreation then can relate to the autonomy with which one chooses to fill one's time (way of life) but may also go towards enhancing social cohesion between participating groups. It could therefore potentially be categorised as either phenomenon. Full explanations of benefits and the coding procedure along with examples from the survey are shown in Table S1.

After responses had been coded, we calculated the frequency of the benefits as a function of the total number of responses. We consider the reliability of frequency as a measure in this study because of the relatively short answers. As students responded with short statements, each benefit is likely only mentioned

once per answer. This avoided that frequency and repetition in long texts may overstate the importance of the theme (Vaismoradi et al. 2013). The results of the content analysis are presented based on the level of which relational value category they fell under as per Table 2 in order to show which relational values were the most dominant. Finally, the results of the content analysis in each cluster identified previously were compared, where possible, to explore the differing themes arising between them. We also compared the clustering and content analysis results of the two schools who took part in the follow-up focus group interviews to further explore these differences.

### 3.2 Focus groups

The follow-up focus group interviews with students and teachers in the two consenting schools were used to validate and further contextualise the survey data. The two classes who participated are from two different schools, labelled School 1 (23 students) and School 2 (19 students) (see Figure 1).

During the sessions with each individual class, we divided the students into three groups via a game. Through the game the groups were randomised which allowed us to avoid friendship interactions and equalise gender distributions (Morgan 1997, pp. 38–40). The first group activity was a drawing exercise, which is considered an age-appropriate way to allow students to explore FESS in a fun and engaging environment (e.g. Bayne et al. 2015). Each group was asked to sketch a forest that they are familiar with along with the activities they undertake there. While drawing, we probed the students to describe the landscape features and activities they were drawing, as well as what kinds of feelings the experiences they were describing gave them.

In the second group activity, we used printed pictures with different forest-related activities and ecosystem services, for example timber harvesting, picking berries, exercising and carbon sequestration. The students were presented 18 options, some of which were variations or repetitions of the same activity or FESS, in order to ensure a more reliable reflection on the part of students. Several dummy options were put in with the cards that did not relate to forests to clarify the preferences of students over

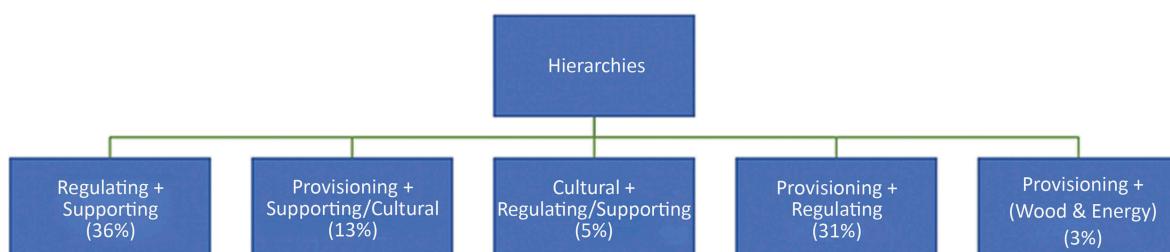
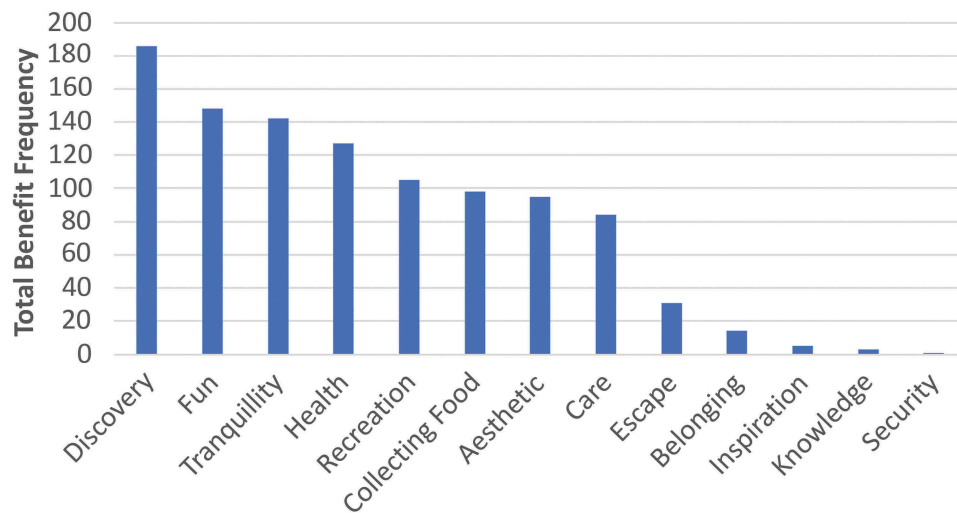


Figure 2. Summary of cluster results simplified from dendrogram,  $n = 296$ .



**Figure 3.** Benefits from forest (x) and total respondents mentioning at least one benefit (n = 397) (y).

other activities. These included photos of playing video games or reading at home. The students were then asked to decide collectively which six options representing a FESS were most important for Sweden as a whole. We recorded the comments made by students as well as our own observations.

Finally, we concluded the focus group session with several questions about the participation in the 'Love the Forest' project. We asked these questions to discern how the students felt about forests after their participation in the project, whether they felt like they learned anything new, and whether their perception or interest in forests had changed as a result.

To analyse the visual and verbal data collected, we conducted a thematic analysis on the visual data and observations made during the focus group activities. While the drawings themselves were a form of visual data, the drawing activity was mostly used as a platform to begin conversations with students about their preferences regarding FESS (Forrest Keenan et al. 2005; Bayne et al. 2015). Visual data from the drawings were initially analysed in the context of which benefits the students themselves identified both through the drawings and short comments left on the drawings explaining the experiences described therein. From this, we created a list of themes to see which were most commonly arising from the drawing activity. This was then viewed together with the observational data we collected during our conversations with students, in the form of personal notes recording comments and observations made by students as well as our recollections from the activities. In analysing both the visual and observational data, we synthesised our findings in the form of a narrative presented in the results section below (Figures 7-8).

This narrative describes our findings as a result of all data collected from the sessions and attempts to provide context to the survey answers given by both classes. This context was intended to provide further information on the feelings and

motivations associated with the students' experiences of FESS and was exploratory in nature. The context highlighted by the narrative presented was a summary of these experiences as they were relayed to us by students and comments by teachers from each school group, and were not confined by a strictly defined coding scheme as with the cluster or content analysis. Given the small sample size of students, these findings only describe the particular contexts in which students from each class reported to enjoy (or not) FESS and only provides generalisations about each class group separately from one another. Findings are limited to the particular groups analysed, and contextual factors described below would require further study to be able to be generalised across a larger population.

## 4. Results

### 4.1 Hierarchical cluster analysis

The data collected via the closed-ended survey question (Q3) focusing on society-level benefits revealed eleven answer types. Answers occupying less than 1% of the total results were excluded, while everything above this was deemed relevant (Figure 2).

Answers identifying regulating and supporting services as the most important formed the most prominent cluster (36% of the total answers), followed by those with provisioning and regulating (31%) as well as provisioning and supporting/cultural services (13% – a cluster which included a mix of secondary answers).

### 4.2 Content analysis

Data from open-ended questions (Q4 and Q5) asking students to identify personal benefits they derive from forest ecosystems were first cleaned of blank



or dummy answers and then coded to determine which were the most thematically dominant ( $n = 397$ ; [Figure 3](#)). When a student described the same benefit in multiple answers, it was only counted once.

[Figure 3](#) presents the results per individual benefit identified in [Table 2](#). Benefits of discovery (appearing in 47% of the answers), fun (37%), tranquillity (36%) and physical and emotional well-being (abbreviated to health – 32%) are the most dominant themes, followed closely by aesthetic appreciation (24%) and ethics of care (21%). By comparison, experiences of escapism (8%) and belonging (4%) scored relatively lowly. In terms of activities, recreation and the collection of food, e.g. mushrooms or berries, were both present (each 25%). For examples of answers and how they were classified, see [Table S1](#).

[Figure 4](#) then displays the relative size of each category of relational value identified above in [Table 2](#) in terms of the total individual benefits that fall within them as a percentage of total answers. Physical and experiential values are clearly dominant, which is unsurprising given it is the value with the highest identified benefits. This is then followed by values relating to physical and mental health, way of life and social cohesion, with cultural identity and sense of place occupying the smallest proportion.

#### 4.2.1 Value comparison between largest clusters

We compared the two largest clusters from the original cluster analysis done (regulating and supporting, and provisioning and regulating) to identify whether there were any differences in their results from the content analysis performed on the open-ended survey questions (Q4 and Q5). This choice of focus was made based on their similar sizes, which ensured

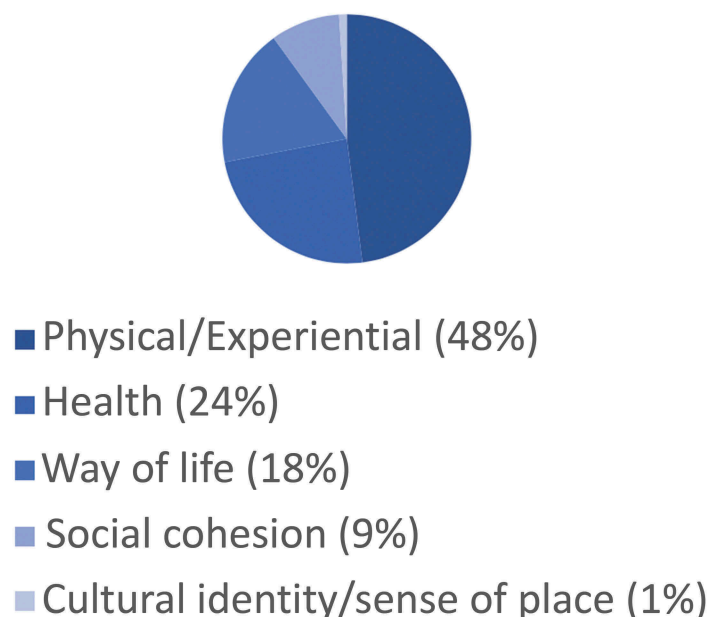
the comparability of the data. Because of the differences in size between the other clusters, this was the only comparison that was possible. There were slight differences in several of the benefits between these answer clusters ([Figure 5](#)).

[Figure 5](#) reveals that, compared with the regulating and provisioning cluster, the frequency at which certain benefits were identified were higher within the regulating and supporting cluster. As shown, health was 8% more frequent and care was 6% more frequent, followed by tranquillity and discovery which were 3% and 2% more frequently identified, respectively. These were expressed as a percentage to account for the slight difference in cluster sizes, with the regulating and supporting cluster containing 111 students and the regulating and provisioning cluster containing 99 students.

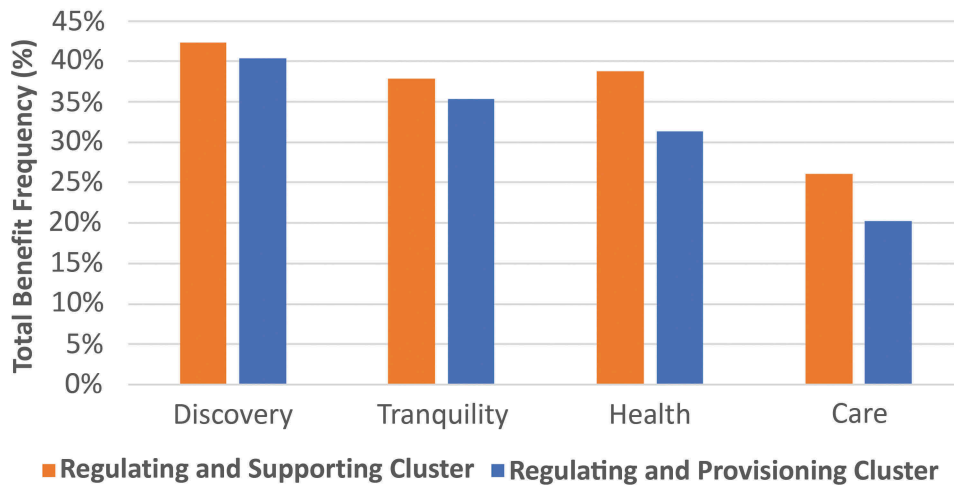
#### 4.2.2 Value comparison between schools taking part in focus groups

A comparison was further undertaken between the two classes from the schools who agreed to take part in the focus group activities, the results of which are given in the next section. [Figure 6](#) displays the differences in results of the content analysis of the open-ended answers given by the students from each school. These are expressed as a percentage owing to the slight difference in size between School 1 ( $n = 63$ ) and School 2 ( $n = 53$ ).

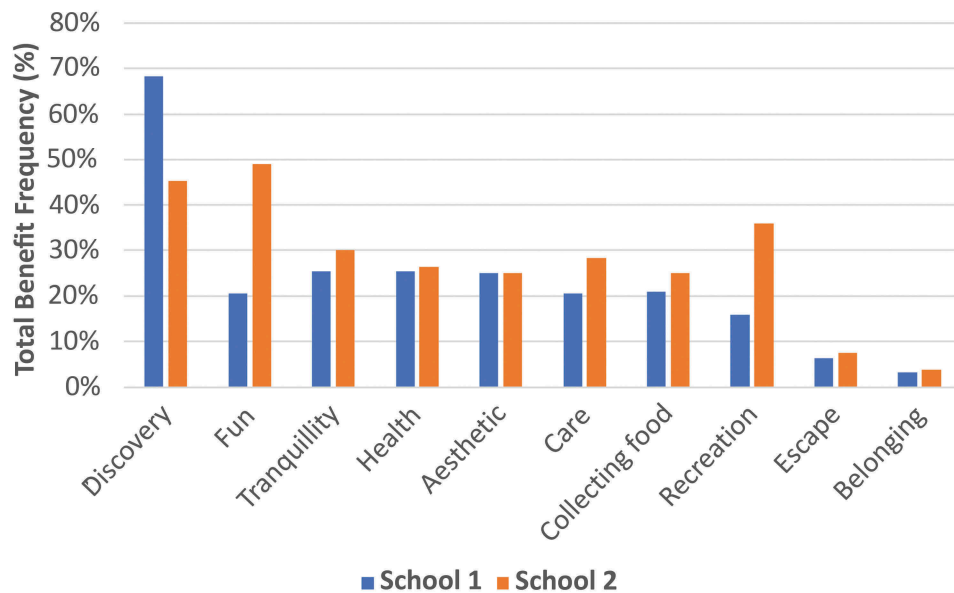
The largest differences lie in the amount of benefits identified relating to discovery, fun, care, and recreation. School 1 consistently identified fewer benefits compared to School 2 in all benefit categories, apart from discovery.



**Figure 4.** Distribution of content analysis results per value category.



**Figure 5.** Comparison between largest ESS clusters on the basis of four most frequently identified values (x) and frequency (%) that they were mentioned per cluster (y).



**Figure 6.** Identified benefits from content analysis (x) and the percentage of answers they appeared in (y).

### 4.3 Focus groups – thematic analysis

#### 4.3.1 Activity 1 – drawing and discussion

The findings from the focus groups largely reflected the findings from the survey but also brought forward several new themes see (see Figures 7 and 8 for examples of drawings produced). As with the survey data, the physical and aesthetic experiences of the forest were amongst the most important aspects for the students. For example, most drawings and discussions told stories of adventures in the forest, centred around the trees, flowers, and animals that could be discovered there. The interactions between students and their environment were fundamentally relational and physical, where immersion in the forest was reflected through activities involving play. These included play-

ing games, creating things from forest materials, picking mushrooms and berries, walking, and climbing trees. The psychological benefits of these activities expressed by students connected these experiences in enabling them to relax, escape from their everyday lives, and be themselves. In addition to this close physical and emotional connection, students also showed a certain knowledge of and respect for what the forest signified. Many students identified the interconnectedness of natural processes within forests as being important for the health of the forests themselves but also for human life, emphasising the balancing of the forces of nature through species diversity and interaction which are fundamental to the health and well-being of the forest and humans alike.

Connected with this, students identified many of the services that forests provide to humans, through climate regulation, provision of materials such as wood and energy, as well as biodiversity.

The activities also revealed several unexpected new themes compared with the survey data. There was a stark difference in the attitude shown towards the forest between the first and second school. Although students from both schools expressed their positive attitudes, for example, through using the forests for play, students from School 1 took a much more negative and trepidatious approach towards being in the forest, and especially when they were on their own. Some even expressed their direct fear and unwillingness to explore the forest in that way. For instance, some students stated that if they had to reach a location where going through the forest would be a direct route, they would take the long way around to avoid it. The students from School 1 were generally less interested in forests and did not give as vibrant or detailed answers as the second school. By comparison, the group from School 2 spoke with much excitement about the activities they would undertake and expressed a fearlessness in their relationship with the forest. They spoke of it as an old friend. To them, the forest is a welcoming environment where they were free to interact with as they willed; playing in streams, hiding in trees, and playing elaborate games using the terrain of the forest were some of the activities of which they spoke most fondly.

The differences between both schools were further clarified in discussions with teachers who suggested several socio-cultural reasons why this might be the case.

The demographic of School 1 was predominantly new Swedes, where the vast majority of children and their parents having come to Sweden as refugees, of which many had rather recently fled from Syria and Somalia. By comparison, the majority of students from School 2 were Swedish born with Swedish parents, and in an established middle-class area. Discussions with teachers from School 1 revealed that parents would not as strongly encourage their children to spend time in forests, or in some cases even discouraging this, related to bad experiences of forests (such as through civil war and a general experience of unsafety). It is possible too that the children themselves have had negative experiences with forests; however, it was not within the scope of this research (neither ethically nor practically) to further probe into these issues. Nonetheless, it hints at the contextual factors which mediate service provision for forests and values of forests perceived within different demographics, discussed below.

#### 4.3.2 Activity 2 – group discussions on society-level benefits

In the second activity, students were required to select six of 18 picture cards representing ecosystem services from forests and forest activities that are most important for Sweden as a country. Generally, students discussed democratically how these six should be chosen out of the 18 options available to them (Figure 9; additional material available in Table S2).

All six groups including both schools identified carbon absorption, the picking of berries/mushrooms, and the importance of the forest for animals

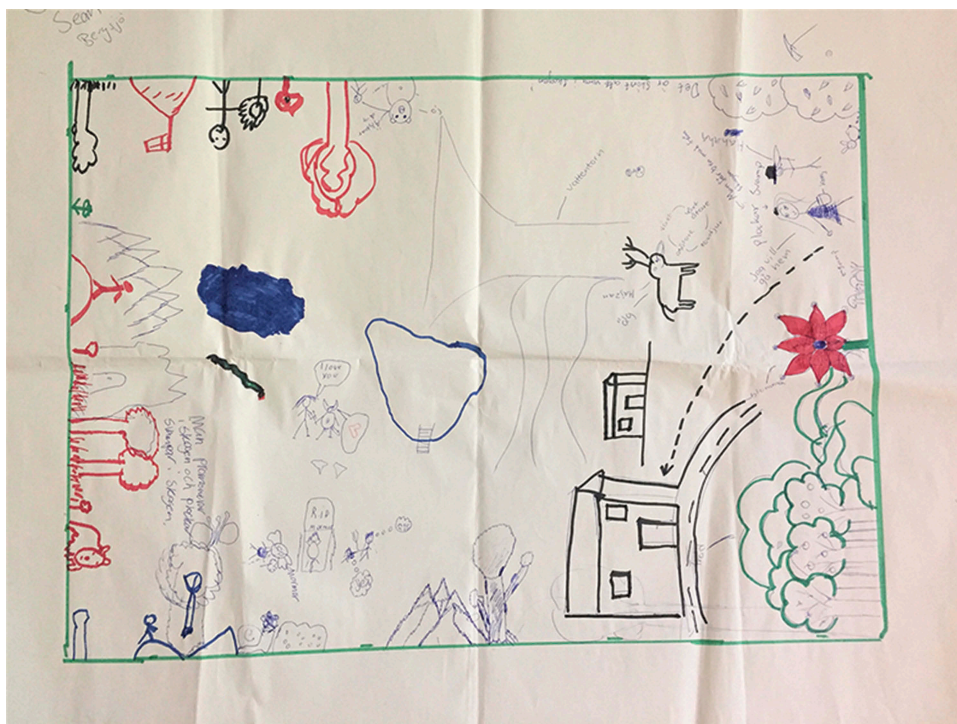


Figure 7. Example of visual data produced by School 1.

as one of the six choices of the most important ecosystem services provided by forests. The interest in carbon absorption can be at least partly explained by the students' involvement with the 'Love the Forest' project, as this was a central theme of the project. All groups in both schools identified picking berries and mushrooms as an important activity, even though the attitudes of the students in both schools towards actually being in forests differed greatly as discussed above. While many students from School 2 expressed they actually were undertaking this activity, many students from School 1 rather acknowledged that this was a potential activity that they rarely, if at all, did or had the opportunity to do.

Students expressed high interest in playing and other activities eliciting feelings of being free, followed by the importance of wood. Only one group selected the dummy option (video games) which indicates that overall students were more interested in the forest over other activities. However, use of devices and the internet did feature in most discussions, which did highlight their prevalence in the lives of the students. Nonetheless, this was still counter-balanced by their interest in escaping the use of technology and exploring the outdoors.

## 5. Discussion

Students prioritised services and benefits in different ways and the kinds of values that emerged depend on the method used to elicit these. In general, the focus group exercise confirmed the findings from the

cluster and content analysis performed on the survey data. The relationships we found embody the different conceptions of value within the ESS and NCP frameworks. Beginning with the results of the cluster analysis, the clusters reflect different elements of value on a spectrum from more intrinsic to more instrumental understandings of value (Figure 10).

Intrinsic conceptions of value were framed as either benefiting non-human life, for example forests being 'good for animals' (i.e. supporting services), or larger processes which regulate the functioning of ecosystems. While the latter is not solely focused on intrinsic value, it emphasises values which are external to humans and for larger systemic processes (Mace et al. 2012; Davidson 2013). The distinction is that value is placed on processes that are primarily 'for non-human forms of life' and 'for humans'. These ultimately interconnected processes are differentiated by their ultimate 'ends', or 'for whom' they are valued (Reyers et al. 2012). Hybrid forms of value, incorporating both the intrinsic value of ecosystems as well as more instrumental concepts of value involving provisioning services, are situated in the middle of the spectrum. Answers which focused heavily on provisioning services are then placed under more instrumental understandings of value expressed by students.

However, there are clear preferences revealed from the volume of answers in each category as well as differences between the underlying values revealed through the content analysis. Intrinsic forms of value were more heavily valued by students and 36% found regulating and supporting services to be the most

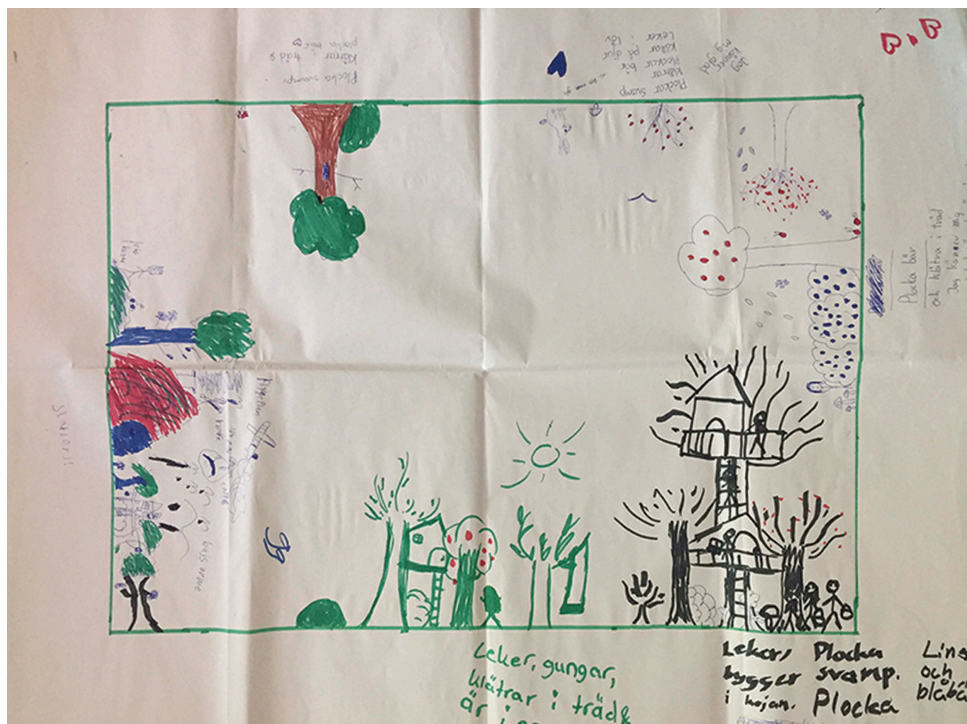


Figure 8. Example of visual data produced by School 2.

important. This was followed by the 31% who valued regulating and provisioning services most highly.

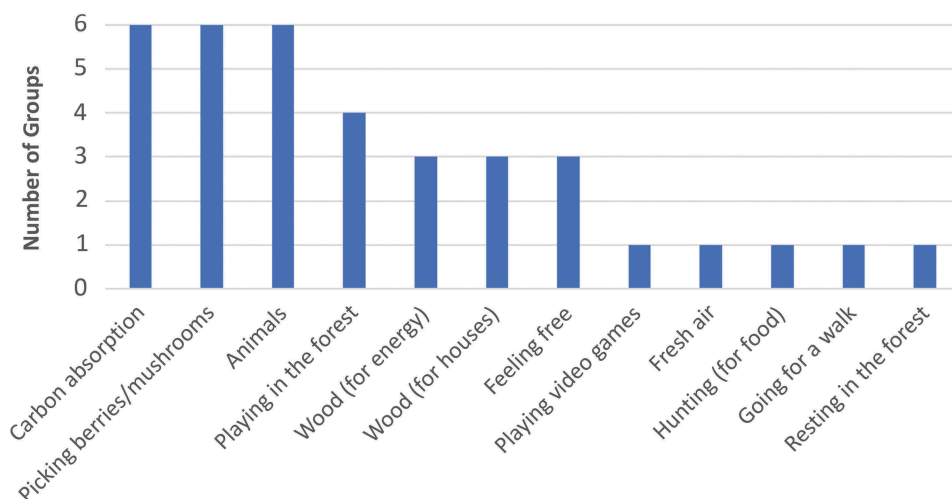
Other differences were found in the values underlying the service preferences. Within the regulating and supporting cluster, the value placed on discovery, health and wellbeing, as well as ethics of care (all cultural values) are more dominant compared to the regulating and provisioning cluster. This suggests that students who valued regulating and supporting services (for example, biodiversity) over-regulating and provisioning services (either wood or energy) had a relationship with FESS which fostered a higher ethic of care (e.g. stewardship) as well as contributions to their health and wellbeing, and elicited a stronger sense of discovery. In other words, as there is more importance being placed on intrinsic over instrumental value, the importance of more interactive and relational values involving a sense of discovery, health and wellbeing, and ethics of care begin to increase. While further work would need to be done to more concretely connect these values and preferences, the data presented here at least suggests a connection as service preferences and ecosystem values are shown to vary across different scales (here societal and individual) and impact one another.

Blizard and Schuster (2005) and Iliopoulou (2018) both found a similar ethic of care shown by students towards forests through deliberative methods (mostly interviews). Blizard and Schuster (2005) discussed the importance of recreational bonding through hut building and other interactional methods of play in developing relationships between students and forests that were suggested by the content and thematic analyses. These values were reflected in the benefits of discovery, recreation and fun contained within the content analysis, and were shown to vary between the schools within the thematic analysis undertaken on focus group data. Corraliza et al. (2012) then probed into the positive correlations between exposure to forests and improved

mental health of children of similar ages through increased relaxation and enhanced emotional resilience.

Furthermore, our results hinted at potentially important contextual factors, for example the different backgrounds of students, which may have mediated the way students ascribed value to forests. This was suggested from the results of the focus group exercises with School 1 and 2, which was further developed by the direct comparison of the content analysis of the answers given by students of both schools in the survey. Most notably, students of School 1 displayed a higher sense of danger and unsafety relating to forests and identified lower benefits relating to fun, recreation and tranquillity (see Figure 6). Interestingly, however, they also indicated a much higher sense of discovery, which may nonetheless indicate a willingness to learn more about local forests. This allows us to hypothesise that the relationship of fear displayed by School 1 might stem from the students' migrant backgrounds as suggested by the teacher of School 1. Previous studies have found numerous other contextual factors mediating value, for example the educational program within which student's study (Barraza and Pineda 2003; Porfirio et al. 2014), the amount of contact with nature (Zhang et al. 2014), and even the education level of the parents of students (Rosalino and Rosalino 2012). Other factors such as age and gender have also been revealed to mediate the way in which children of similar ages relate to forests in different ways compared to adults (Uitto et al. 2011).

Cultural understandings of values based on ethnic associations have also been shown in some studies to play a determining role in the way children value forest ecosystems (Stevenson et al. 2013), which is also reflected within our findings. Our findings support Jay and Schraml (2009) and Buijs et al. (2009), who explored differing use habits and values ascribed



**Figure 9.** Selection of activity to undertake in the forest from provided range (x) and the number of total groups including this within their favourite activities (y).

to forest ecosystems based on the migrant versus non-migrant backgrounds of participants. Similar connections were found where the value ascribed towards forest ecosystems was found to be lower among people with an immigrant background based on differing cultural perceptions of forests.

These diverse findings and analysis of the results of our study were strengthened by the broad conception of value used as well as the mixed-method approach that was taken. Methodologically, our findings support the approach taken by the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) in incorporating diverse forms of value into valuation methods, as well as by taking a mixed-methods approach (Diaz et al. 2015; Kok et al. 2017; Pascual et al. 2017). We used the NCP framework to operationalise relational values through a mixed-method approach. While the methods used alone may not be novel, combining them in taking an integrated approach through a unique value framework represents a relatively new approach to ecosystem valuation (Pascual et al. 2017). Further, each method added another layer of detail which ultimately offered a unique perspective on the question of value, reinforcing one another to develop a more detailed tapestry of values ascribed to FESS by school children.

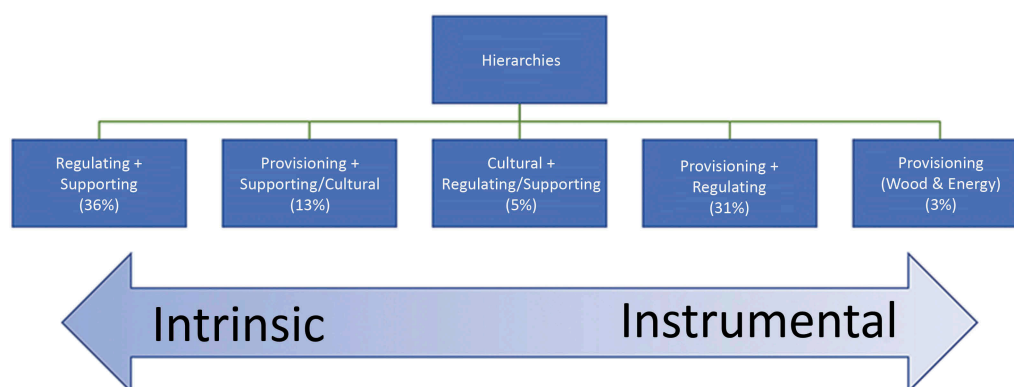
In adding further detail to value perspectives on FESS, we sought to develop and operationalise how relational values can be explored through ecosystem service assessments. The content analysis was particularly important in this regard, as our synthesised framework of relational value categories, along with the specific benefits that each provide, put to test the idea of relational values in a real-world example. It was clear from the results that physical and experiential values were the most observable from the survey data, as the benefits associated with these values were present in almost half of all answers (Figures 3 and 4). While this category also had the highest number of benefits of all value categories, it also suggests that this form of value was most appreciated by the population studied. This was followed by values relating to physical and mental health, as well as values

involving the way their relation interactions with ecosystems impact the way of life of participants in a positive way. Values involving social cohesion, cultural identity and a sense of place were comparatively low, with the latter only being present in little over 1% of the answers. Reasons for this could be attributed to the relatively young age of participants, as they may not yet have such a strong appreciation of these concepts. Alternatively, this could be attributed to the coding procedure, which may not have adequately captured the ways in which the participants experienced the values and benefits associated with this category. Future work should develop these categories of values and benefits within ecosystem service assessment processes to develop further how they can be found methodologically.

In addition, further studies would also be best directed towards refining the way in which deliberative methods can be used not only to elicit relational values but also to understand how relationships form and can be further developed in context. Potentially, this information can direct governance practices in a way that facilitates and encourages these relationships to grow and flourish.

### 5.1 Practical and theoretical implications of the study

The conceptual and methodological discussion on value provoked by this study speak to the philosophical dimensions of ecosystem valuation. How value was constructed through different methodological processes was shown to change the way in which value was perceived and mediated, which may have implications for ecosystem service valuation in environmental policy. Newer paradigms, such as the NCP framework, represent a shift towards concepts of value underpinned by individual and societal relationships between people and nature, rather than an idea of value that limits nature to a means to an end (Kadykalo et al. 2019). While conceptually these forms of value are not novel, what is novel is their potential inclusion in a meaningful



**Figure 10.** Spectrum of value concepts derived from cluster analysis of the survey data where each category represents one group of student's answers in the survey.

way in management frameworks attempting to capture the diversity of values held by different groups of society (Klain et al. 2017).

We presented a methodological approach showing how to construct valuation processes which can capture diverse forms of value among school children, encompassing instrumental, intrinsic and relational forms of value alike. Without acknowledging several forms of value, it is not possible to give full account to the kinds of answers students gave in both the open-ended questions (Q4 and Q5) as well as the focus groups undertaken. Many of these answers related to more intangible services and benefits received. These services and benefits related to fundamentally relational concepts, such as discovery, tranquillity, aesthetic appreciation as well as ethics of care and stewardship over forests. These forms of value were not merely instrumental, but rather speak to deeper held and more intimate connections with the landscape. The focus group activities with School 2 revealed a sense of comfort and curiosity in student's interactions with forests, which could not be reduced to a means to an end of enhancing their well-being. Rather, any well-being produced may be a result of their relationships built (or not) over their lives. This in turn could suggest that the value ascribed by students from non-Swedish backgrounds were mediated by their differing perceptions of the safety of forests based on differing relationships with forests. While a larger sample group would be needed to explore this further, this highlights the importance of contextual factors in valuation, for example differing cultural representations of ecosystems, to understand how value is perceived.

Developing novel approaches to valuation that incorporate diverse understandings of value is critical in order to make informed decisions for sustainable management of natural resources and environmental governance. Diversifying the conceptions of value reflected through management practices and valuation methods is necessary to give full account of the ways in which any changes to management practices or ecosystem health have on the everyday lives of local people (Liu et al. 2010; Jacobs et al. 2016). Local stakeholder perspectives are important in the mosaic of value narratives presented through valuation processes (Kok et al. 2017; Pascua et al. 2017). Incorporating diverse stakeholder needs further aligns with the conservation goals of the Swedish government, highlighting the need to preserve multi-use forests in ensuring sustainable development (Regeringskansliet 2018, pp. 11–12). Demographical focuses such as those presented in this study are therefore invaluable in advancing these narratives in being able to test and refine methodological approaches to constructing value.

In relation to the particular demographic in our study (school children), education is key in instilling value for ecosystems (Barraza and Pineda 2003; Porfirio et al.

2014). There is a mandate to ensure that new generations of young people can engage and connect with ecosystems through, for example, social learning processes within more deliberative methods in ecosystem valuation processes (e.g. Reed et al. 2010). Relational values can thereby be transferred on an intergenerational scale from one generation to another. There is a clear need for working and enhancing relational values in light of the risk of youth disengagement with nature and ecosystems. The cost of this disengagement is a potential threat not only to nature conservation efforts in the future but also the physical and mental well-being of children (Zhang et al. 2014). As suggested by Teacher 1, further engagement with forests in the particular case of Sweden may also help integration of people into Swedish society and the appreciation of the local environment. Such thoughts are supported by the increased interests in Scandinavia for 'nature-based integration' that is being proposed as an alternative and improved means for integration. This is particularly relevant since forests and outdoor recreation are a key lifestyle in Sweden and other Nordic countries that also share a similar public right of access to natural areas (Nordic Council of Ministers 2017).

In regards to education and integration in the context of our results, the content analysis further supports the idea of nature-based integration and show that the students from School 1 are highly curious to learn more about forests, even more so than their peers in School 2 with a more homogenous Swedish cultural background. However, the sense of care towards the forest among students in School 1 was lower than that of School 2, which shows that more work is to be done to enable this curiosity to flourish into an enhanced appreciation of forest ecosystems.

On the level of the science-policy interface, our findings provide a starting point to improve the way that environmental education for young people can be structured to cultivate an understanding of the broader values of forest ecosystems. The 'Love the Forest' project within which data were collected for this study is one example out of several initiatives in Sweden where young people learn about society-nature interactions through collaborations between civil society actors, the forestry sector and schools (for example, *Skogen i Skolan* and *Friluftsförbundet*). The methods we used provide valuable insight into the state of knowledge that students have about forest ecosystems and their interaction with forests. It further offers guidance for how future projects of this kind can be optimised in tailoring the contents and focus of activities to the particular characteristics of participating student groups, while also ensuring that instructors and teachers have the required knowledge and sensitivity to address them.

In the particular case of Sweden, Swedish primary education has the objective to teach children about the preconditions for a healthy environment and sustainable

development. In physical education and health, the links between mental and physical health and outdoor activities are underscored while the need for outdoor discovery and experimental learning is emphasized during biology classes (Skolverket 2018). These school-based activities can strengthen and further foster the development of relational values, which is particularly relevant in times when adolescents' self-reported psychosomatic health complaints are frequent (Potrebny et al. 2018) occurring in conjunction with sedentary lifestyles dominated by 'screen time' that involve less physical activity (Norberg 2017). Interacting with the natural environment through the educational system is even more relevant when such activities encourage participation across diverse socio-economic and cultural backgrounds. Following this, and based on our findings, we encourage further studies on how relational values are experienced by children, as well as how they can be cultivated in order to instil and strengthen an appreciation of the natural environment. This could further counteract the social and political tendencies to represent ecosystems such as forests as merely resource providing units of land cover.

## 6. Conclusion

Our findings confirm the need expressed in recent literature for more holistic conceptions of value to be expressed within valuation processes. This is necessary to ensure that the total value of ecosystems can be constellated, without ignoring benefits and values that cannot be easily or convincingly grouped as either intrinsic or instrumental. As a result, a more informed discussion can be started on the relationship between ecological and social values whereby they can be understood as mutually reinforcing one another. For example, social values in ecosystems can be used as a vehicle to drive interest in protecting and enhancing ecological value that can in turn further grow the social value placed within them (Ruiz-Frau et al. 2018). Furthermore, our results contribute to existing knowledge on the use of deliberative and statistical methods to elicit relational values in practice (Klain et al. 2017), as well as offers direction to future work developing how these values are understood in ecosystem service assessments. Overall, the findings presented here are a call to open the discussion to include a broader range of methods, values and stakeholders in deciding over future management practices of forests through its intergenerational focus on future land managers and users.

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